The lantern slides are a little enlarged from the original negatives. On the slides from the reflector-plates 1 degree equals 86 mm., and on the slide of the $1\frac{1}{4}$-in. lens 1 degree equals 4 mm.*

It is interesting to compare photographs 7 and 8, which were taken at the same time, but with very different optical means—28-in. and $1\frac{1}{4}$-in.

The tail on No. 8 is somewhat over 12 degrees long, while the small field of the reflector gives the head and its neighbourhood only. The bright star near the head of the comet on No. 8 is γ Geminorum.

* In the reproduction on Plate 6 one degree on the reflector plate = 79 mm., and one degree on the $1\frac{1}{4}$-in. lens plate = 3·7 mm.

Astrophysical Observatory,
Heidelberg (*Königstuhl*),
1907 *December* 10.

On an improved method of illuminating the field in a Transit Instrument, and its effect on the discordance in reversed positions of the instrument. By Sir W. H. M. Christie, K.C.B., F.R.S., and H. A. H. Christie, B.A. (Plates 7, 8.)

It is known that with a reversible transit instrument observations made in the two positions of the instrument generally show discordant results for clock error for stars reduced with the same collimation error for the two positions. This discordance has been attributed to what is called lateral flexure, and a correction depending on cos Z.D. has sometimes been applied, but at Greenwich we never felt satisfied that there was any real ground for this assumption. We have suspected sometimes that it was due to looseness in the mounting of the object-glass, and in the Paris-Greenwich longitude determination of 1888 this was found to be the case with both the portable transits. But though this was remedied by an improvement in the mounting of the object-glass, this puzzling discordance still remained in subsequent longitude determinations. Whilst there is in each series of observations a general tendency in one direction, there are considerable variations in the discordance between the mean clock errors for each night in the two positions of the instrument, as will be seen from Tables I., II., III., IV., V., VII., and VIII.

Mr. Hollis, on thinking over the matter in connection with the observations for longitude of Killorglin in 1898 and of Paris in 1902, had come to the conclusion that to obtain the correct clock-error from the mean of results in reversed positions it was necessary to keep the focus of the eyepiece absolutely fixed, and that to secure this it was expedient to keep the diagonal eye-tube which was used for the observations, and was liable to sag, rigidly attached to the tube of the instrument. In the Paris longitude

observations in 1902 special attention was paid to this, the eyepiece being adjusted to focus at the beginning of the evening, and not altered afterwards. The discordance, however, was not altogether got rid of, and on some nights it exceeded $0^s.2$ or $0^s.3$. There was the further difficulty that, as will presently be explained, the observer's eye is liable to change of focus when the bright star comes into the field.

In 1906 and 1907 Mr. Harold Christie was working with two of the portable transits (B and C) previously used in the Paris longitude determinations of 1888 and 1902, with a view to other longitude determinations, and the large discordances in his results for the two positions again called attention to the question. He noticed that if the eyepiece was adjusted for distinct vision of the wires in an illuminated field a fresh adjustment was required when the star appeared, the eyepiece having to be pulled out further from the object-glass owing to change in the focus of the eye, the wires being, by an unconscious mental process, naturally referred to a finite distance (say 2 or 3 feet), and the star, when it came in, to an infinite distance. This change of focus still took place when the other eye was covered up. He further noticed (on March 1, 1907) that while adjusting the eyepiece for focus on a slow-moving polar star the star seemed to cross the wire from one side to the other as the eyepiece was moved in or out, the apparent movement of the wire being as much as 20″. A similar effect had been previously noticed on the meridian mark (a bright point) seen in an illuminated field. It was at first thought that this might be due to the wires not being exactly in the focus of the object-glass, but readjustment of the focus failed to get rid of the effect. On trying the same experiment on Polaris by daylight next day it was found that no apparent movement of the wires could be got by movement of the eyepiece in or out. This indicated that the effect was due to *illumination of the field.* It was further noted that the movement was less apparent with a strong illumination than with a reduced light. It may here be explained that the illumination of the field is given by a gilt annular reflector in the transit axis, the inclination of which can be varied from a minimum of 45° to a greater angle with the axis so as to reduce the light.

Afterwards observations of stars were made with the eyepiece inside the focus, at the best focus, and outside focus. The results were that the discordance W—E was positive and large ($+1^s.5$) with the eyepiece far in, and negative (about $-0^s.6$ or $-0^s.7$) with the eyepiece far out.

It is to be observed that the mean of the results W and E is sensibly unaffected by the discordance, as will be seen from the last column.

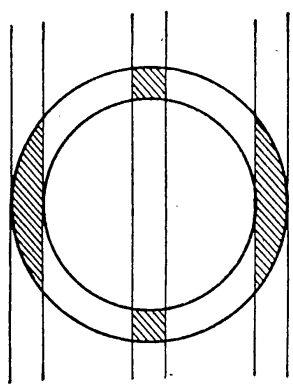
Transit C.—Annular Illumination Experiments with Eyepiece focus.
By Mr. H. Christie.

Date.	Position of Eyepiece.	No. of Stars. W. E.	W—E.	Mean. Clock slow.
1907.			s	s
March 19	Good focus	2, 2	+0·15	+59·48
	Inside focus	1, 2	+1·45	59·66
	Outside focus	2, 2	−0·73	59·45
March 20	Good focus	3, 2	+0·58	59·92
	Inside focus	2, 2	+1·40	59·91
	Outside focus	3, 3	−0·55	59·96

N.B.—The "good focus" position was the ordinary one for star observations; the eyepiece was displaced from this position until observation was only just possible.

These experiments seemed to clearly establish the connection between the discordance and eyepiece focus, and they further suggested that the annular reflector was in fault.

It is to be noted that the wires at night are not seen by their own light, but as dark shadows cutting off the light of the illuminated field, and thus the illuminating surface, which casts the shadow of the wire, has an important influence on its appearance with the annular reflector. When the wire is out of focus the



shadow of each point of the wire is an annulus, and the superposition of these will give two dark lines parallel to the wire with a comparatively slight haze between, the two sides of the annulus being more effective in forming the shadow images than the top and bottom, as will be seen from the accompanying figure, which shows the portions of the annulus at the sides and at the top and bottom respectively, which are effective in forming the corresponding shadow images of a vertical wire. Thus two fairly clear and separated images are formed one on each side of the true position of the wire.* Now if one side of the annulus is more distinctly

* On examination of the wires by daylight illumination from the object-glass, it was found that when the eyepiece was out of focus, instead of two images a single image was seen, with bands on each side.

lighted than the other, and the whole illumination of the field is not very bright, the eye will lose one of the two images of the wire, and only see a single image, which will appear fairly clear, and will be displaced by an amount depending on the diameter of the out-of-focus annular ring.

On investigation this proved to be the case. When the annular reflector was at an angle of 45° to the axis (giving a maximum of illumination) it was fairly evenly illuminated, but when the inclination was increased, in order to reduce the light to a convenient amount for star-observing, one side of the gilt reflector became considerably brighter than the other. This was the actual position always used in practice, as the full illumination was too strong for observing stars. Also, it was found that the side of the reflector which gave most light was the one which would, by the above theory, cause the clock error micr. W to be greater than the clock error micr. E, as the star-observations showed to be the case. In order further to test this, Mr. H. Christie made observations on April 5, 6, and 10 with the reflector kept at 45° to the axis (a rheostat being used to reduce the light from the electric lamp), and obtained better results.

It had long been felt that illumination by means of an annular reflector in the transit axis was not satisfactory, as the image formed at the eye-ring from the illumination of the field was an annulus outside the circle formed by a star, and there was risk of the eye failing to receive the whole of the rays on both sides coming from the reflector.

Illumination by rays coming centrally within the cone of rays from the object-glass would be preferable in this respect, but there are objections to the way in which this has usually been carried out. In 1870, Sir G. B. Airy successfully applied central illumination to the Water Telescope which he planned, mounting a piece of looking-glass at an angle of 45° in front of the object-glass to receive the light from a gas flame, without any condensing lens. In this way the light was well diffused over the field, the gas flame as well as the mirror being well out of focus at the plane of the wires.

But in other forms which have been used since, a condensing lens with a small electric lamp in its focus has been introduced, which, in combination with a small reflecting prism or other specular reflector fixed in front of the object-glass, forms a magnified image of the source of light in the plane of the wires, exaggerating its defects, and making it difficult to get tolerable uniformity of illumination of the field and sharp definition of the wires.

In planning the New Altazimuth, a sketch arrangement was proposed in 1896 January for central illumination by light reflected from the axis lamp inside the telescope tube to a matt surface gilt reflector attached centrally to the inside surface of the object-glass; but, owing to practical difficulties, this plan was not carried out, and the ordinary annular reflector in the axis was at first

used. In 1897 September central illuminations by the usual method of small reflecting prism ($\frac{5}{8}$-inch square) cemented on the outside of the object-glass and collimating lens with a small electric lamp in its focus was arranged for, and was subsequently brought into use. There was difficulty, however, with the illumination, owing to the filaments of the lamp forming an enlarged image in the focus, and the wires were badly defined, owing, as afterwards appeared, to diffraction effects from the small aperture of the illuminating pencil. Further, with such a small pencil, dust on the field lens of the eyepiece would be sensibly in focus with the wires.

Attention being again called to the question, it seemed that too much importance had been given to simply getting enough light without sufficient consideration of the optical conditions required in the arrangement for central illumination of the field. These conditions are :—

(1) That a uniform illumination shall be secured over the field, without such defects as are due to the source of light coming to a focus near the plane of the wires.

(2) That the illuminating pencil should have a sufficient aperture to minimise diffraction effects on the wires, giving rise to shadow-bands.

The condition (1) can be secured by substituting a matt surface, such as opal glass (finely ground) or plaster of Paris, for the specular reflector, the condensing lens with electric lamp in its focus being retained. The parallel rays which fall on the matt surface from each point of the source of light in the focus of the condensing lens are scattered uniformly in directions slightly inclined to the axis of the telescope, and, after passing through the object-glass, converge respectively to each point of the field, so that each point is illuminated by a pencil uniformly distributed over the whole of the opal reflecting surface.

As regards condition (2), it is to be borne in mind that in transit observations sharp definition of the wires is as important as sharp definition of stars; and that, as the wires are seen as shadows thrown by the illuminated field, the aperture of the illuminating pencil determines the sharpness of the wires. With the small pencils which have commonly been used even on large instruments, there are necessarily large diffraction effects which are serious with the relatively very high powers employed. At the same time it is to be noted that comparatively little loss of light, and practically no loss of definition for a star, is entailed by cutting out a circle of, say, one-fourth of the aperture at the centre of the object-glass.*

After some preliminary experiments with central illumination for the portable transit, the following arrangement was adopted on 1907 May 8 to secure the two conditions stated above. An elliptical finely ground opal glass was used as the reflector, and mounted in a brass tube which was attached to the outer surface of the object-glass by shellac. The illuminating source was a small

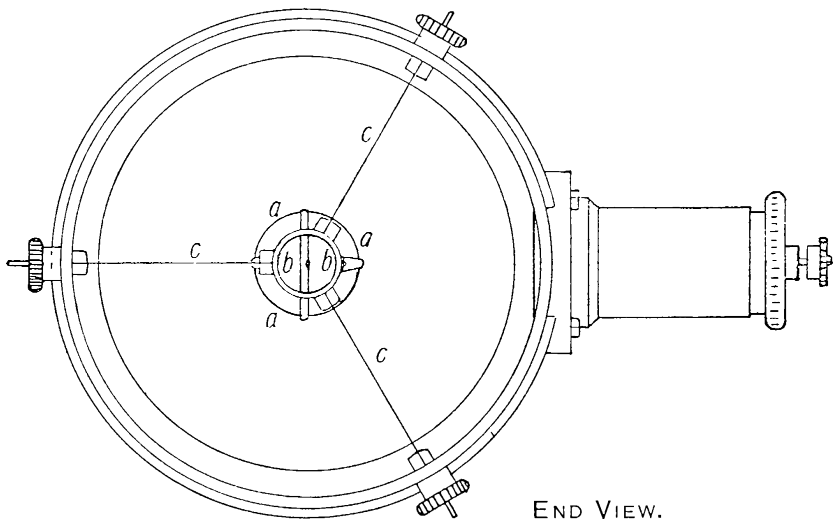
* The loss of light would in this case only be one-sixteenth.

electric lamp in the focus of a condensing lens, throwing a parallel beam of light on the opal reflector. The brightness of the electric lamp was controlled by a rheostat, and a very satisfactory illumination of the field, with the wires sharply defined, was obtained. The diameter of the pencil of rays from the reflector was $\frac{3}{4}$-inch, which was adopted as suitable for the 3-inch object-glass. The results given for Transit C, in Table IX.—central illumination —were all obtained with this arrangement. It was found, however, that the shellac was not a secure fastening for such an instrument as a portable transit, as any jar was apt to dislodge the arrangement, so a more secure form of support was adopted later on, and applied first to transit B in July 1907. This consisted of an opal reflector as before, fixed to the dew cap by three pieces of watch-spring, and is shown in Plate 7. This arrangement was found satisfactory, and so was attached to the other instruments (transits B and D) as well. No trouble has been caused by diffraction effects. The observations obtained are, on the whole, satisfactory, although two nights (September 10 and 11) with transit B give discordances W—E of over $0^s \cdot 1$. There was probably some other cause at work on these nights, as the collimation determined from the nadir gave a sudden jump of about $2''$ in the *opposite* direction to the error shown by the stars (Tables VI., IX., and X.).

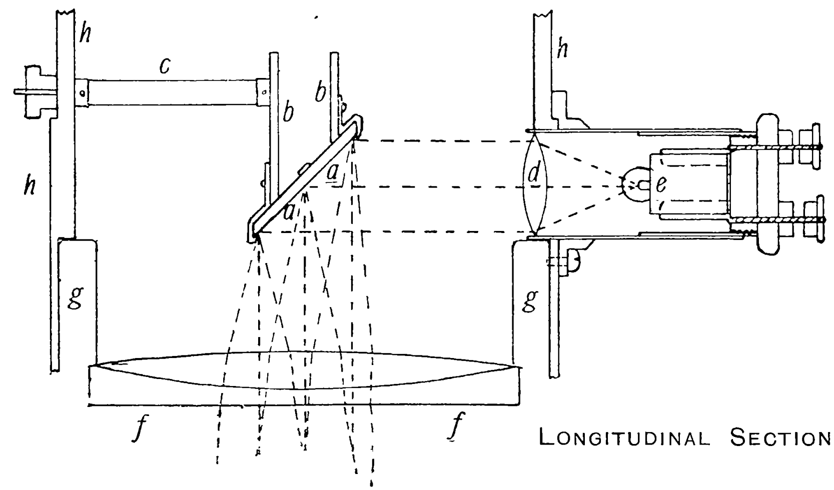
As the application of the improved central illumination to the small transits proved so successful, it was applied to the New Altazimuth on 1907 June 5, the mode of attaching the reflector to the object-glass being slightly modified from the original plan with shellac cement. In order to secure a firmer attachment, a plain glass plate, worked slightly concave on the outside to fit the curvature of the outer surface of the object-glass, was burnished into the end of the tube carrying the opal reflector, and cemented on to the object-glass with Canada balsam. In this way the obstruction of light due to the attachment is reduced to a minimum, viz. the thickness of the brass tube. The general arrangement is shown in Plate 8. The aperture of the illuminating pencil adopted for the 8-inch object-glass was $1\frac{1}{2}$ inches, which was found to give greatly improved definition of the wires, which had been very unsatisfactory with the $\frac{5}{8}$-inch pencil formerly in use. At the same time the troublesome markings previously seen in the illuminated field were got rid of, and a satisfactory uniform illumination substituted.

It is proposed to apply a similar method of illumination to the Greenwich transit-circle as soon as the necessary electrical connections can be made.

The tables show the difference between the mean clock error determined with the instrument micrometer West and micrometer East respectively. They are corrected for clock rate and reduced with a collimation error determined from nadir observations only. The weights given depend on the number of reversals of the instrument, a weight of 1 corresponding to a single reversal, while a weight of 2 corresponds to two or more.



END VIEW.

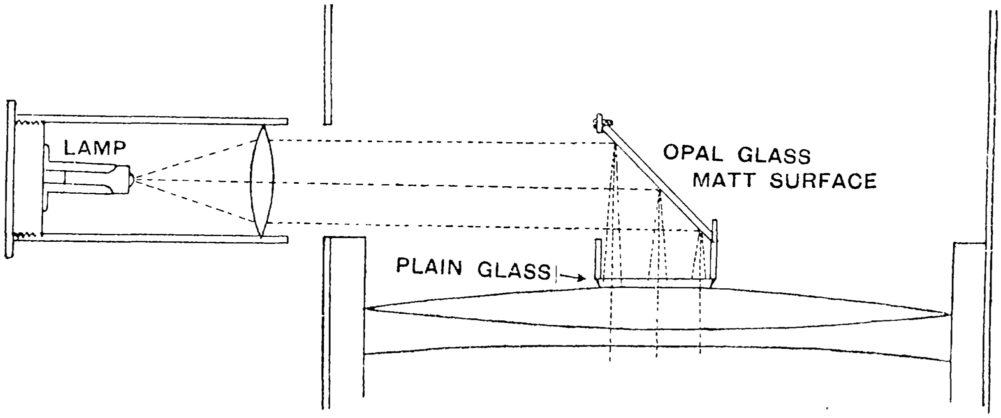


LONGITUDINAL SECTION.

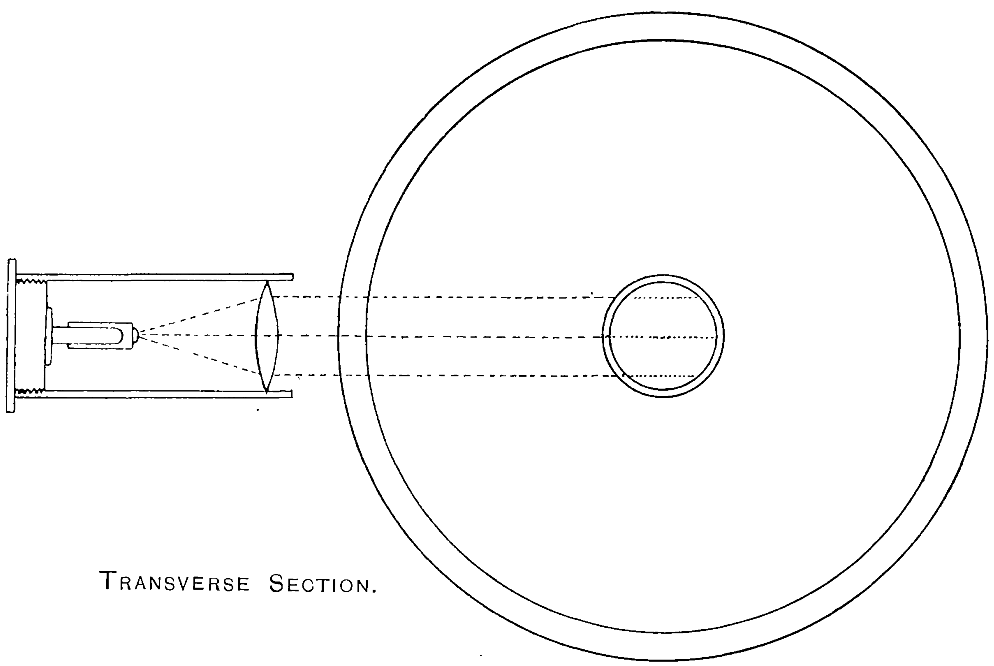
PORTABLE TRANSIT—ILLUMINATION OF FIELD.

a, Matt surface reflector (Opal glass finely ground).
b, Brass tube to carry reflector.
c, Supports for tube, made of watch-spring.
d, Condensing lens.
e, Small electric lamp.
f, Object-glass of telescope.
g, Object-glass cell.
h, Dew cap.

Altazimuth—Illumination of Field.



Longitudinal Section.



Transverse Section.

TABLE I. TABLE II.

Transit B.—Trial Observations by Mr. Dyson and Mr. Hollis.

Annular Illumination.

Date. 1898.	W—E. Means.	Observer.
	s	
June 25	+0·16	H
July 2	+0·26	H
8	+0·14	H
16	+0·25	H
Aug. 2	+0·39	H
Sept. 3	+0·30	H
21*	+0·82	H
23*	+0·69	H
23	+0·16	H
23	+0·19	D
26	+0·35	H
26	+0·37	D
Mean	+0·340	

On Sept. 20 the object-glass was taken out, examined, and replaced.

* Ramsden eyepiece with prism used for these observations instead of diagonal eyepiece.

Date. 1901.	W—E. Means.	No. of Stars. W. E.	Obsr.
	s		
Nov. 23	+0·37	7, 7	H
Dec. 2	+0·40	4, 5	H
4	−0·02	4, 5	H
10	+0·20	7, 6	H
10	+0·25	4, 5	H
16	+0·34	6, 5	H
16	+0·41	5, 4	H
1902.			
Jan. 25	+0·32	5, 5	H
28	+0·38	4, 6	H
Feb. 10	+0·49	5, 5	D
11	+0·08	6, 6	D
Mean	+0·293		

On Dec. 10 the position of the illuminating lamp was altered and purposely made unsymmetrical, an apparently bad arrangement.

TABLE III.

Transit B.—Observer, Mr. Dyson.

Annular Illumination.

Date. 1902.	W—E. Means.	No. of Stars. W. E.	Wt.
Paris.	s		
Mar. 18	−0·143	6, 5	1
19	−0·065	19, 12	2
23	+0·002	11, 17	2
25	+0·140	12, 19	2
28	−0·047	12, 13	1
Mean	−0·005		

Date. 1902.	W—E. Means.	No. of Stars. W. E.	Wt.
Greenwich.			
Apr. 6	−0·036	5, 5	1
8	+0·046	14, 15	2
10	+0·137	10, 8	1
12	+0·066	11, 9	1
13	+0·107	18, 21	2
17	−0·005	18, 16	2
18	+0·076	18, 18	2
20	+0·034	7, 8	1
22	+0·030	15, 16	2
23	+0·108	22, 21	2
24	+0·134	21, 18	2
Mean	+0·066		

TABLE III.—*continued.*

Date. 1902.	W—E. Means.	No. of Stars. W. E.	Wt.	Date. 1902.	W—E. Means.	No. of Stars. W. E.	Wt.
Paris.				Paris.			
Apr. 28	+0·088	13, 20	2	Oct. 6	+0·068	10, 7	1
May 1	+0·059	20, 17	2	7	+0·127	12, 16	2
3	+0·024	18, 17	2	8	+0·029	6, 10	1
Mean	+0·057			9	−0·006	9, 9	1
				10	+0·047	17, 17	2
				13	+0·113	12, 7	1
				14	+0·080	20, 20	2
				16	+0·076	15, 17	2
				17	+0·073	21, 19	2
				21	+0·051	19, 15	2
				22	+0·024	16, 15	2
Greenwich.	s			Mean	+0·064		
Sept. 21	+0·015	3, 2	1	Greenwich.			
22	+0·099	18, 19	2	Oct. 26	+0·149	9, 2	1
23	−0·004	8, 5	1	27	+0·212	11, 11	1
24	+0·158	19, 18	2	29	+0·048	18, 19	2
25	+0·087	8, 10	1	30	+0·005	21, 10	1
26	+0·127	17, 16	2	Nov. 1	+0·107	9, 8	1
Mean	+0·096			2	+0·040	9, 8	1
				3	+0·114	6, 9	1
				4	+0·101	24, 23	2
				Mean	+0·093		

TABLE IV.

Transit B.—Observations by Mr. Storey and Mr. Witchell.

Annular Illumination.

Date. 1906.	W—E. Means.	No. of Stars. W. E.	Obsr.	Date. 1906.	W—E. Means.	No. of Stars. W. E.	Obsr.
	s				s		
Jan. 22	+0·07	6, 6	J. S.	Jan. 30	+0·15	4, 4	J. S.
23	+0·06	4, 2	W.	Feb. 3	+0·03	4, 4	J. S.
24	+0·13	7, 6	J. S.	April 4	+0·04	4, 4	J. S.
26	+0·09	7, 6	J. S.	9	+0·17	4, 3	W.
29	+0·15	4, 4	W.	19	+0·12	5, 5	W.
				Mean	+0·101		

On some other nights individual stars are very discordant; in one case there is a range of one second of time.

Table V. Table VI.

Transit B.—Observer, Mr. H. Christie.

Annular Illumination.

Date. 1906.	W—E. Means.	No. of Stars. W. E.	Wt.
	s		
July 16	+0·081	2, 6	1
18	+0·369	4, 5	2
20	+0·868	5, 7	1
23	+0·480	3, 6	1
24	+0·584	7, 7	1
25	+0·972	15, 7	2
31	+0·368	8, 6	1
Aug. 7	+0·703	7, 4	1
Sept. 20	+0·093	3, 7	1
25	+0·744	5, 7	2
28	+0·521	4, 2	1
Oct. 9	+1·057	3, 9	1
11	+0·409	2, 2	1
22	+0·725	2, 3	1
23	+0·088	2, 3	1
27	+0·455	4, 3	1
Mean	+0·558		

Central Illumination.

Date. 1907.	W—E. Means.	No. of Stars. W. E.	Wt.
	s		
July 30	+0·053	3, 4	1
Sept. 7	+0·091	7, 8	2
9	+0·089	8, 8	2
10*	+0·109	8, 7	2
11*	+0·131	7, 7	2
15	−0·030	4, 4	1
19	+0·038	5, 6	2
24	−0·023	9, 12	2
25	−0·052	7, 7	2
26	−0·034	15, 15	2
Oct. 4	+0·004	8, 8	2
Mean	+0·036		

Observer, Captain Monro, R.N.

Date. 1907.	W—E. Means.	No. of Stars. W. E.	Wt.
Sept. 16	+0·042	4, 3	1
17	−0·052	6, 6	2

Note.—The observations in Table VI. (Central Illumination) were all reduced with the same collimation error throughout; there appears to have been a slow change of collimation, which was also shown by the nadir observations. No correction has been applied for inequality of the pivots. The mean of a number of determinations made by the striding level in 1902, when the pivots were last reground, was 0″·00.

* On September 10 and 11 the nadir readings for collimation are very discordant, differing by about 1″ from the mean. The clock stars appear to be affected also, but with the opposite sign.

Table VII.

Transit C.—Observer, Mr. Hollis.

Annular Illumination.

Date. 1902.	W—E. Means.	No. of Stars. W.	No. of Stars. E.	Wt.
Greenwich.	s			
Mar. 17	+0·128	15,	12	2
19	+0·106	17,	17	2
20	+0·056	10,	12	1
21	+0·086	10,	7	1
22	+0·066	14,	11	1
23	+0·111	8,	8	1
25	+0·260	16,	18	2
27	+0·416	13,	10	1
28	+0·070	14,	5	2
Mean	+0·143			
Paris.				
Apr. 7	+0·303	10,	8	1
8	+0·316	9,	2	1
9	+0·067	10,	15	1
11	+0·095	9,	11	1
13	+0·267	16,	18	2
17	+0·217	17,	16	2
18	+0·221	17,	16	2
20	+0·162	18,	11	2
21	+0·166	16,	16	2
23	+0·260	9,	15	1
24	+0·137	17,	19	2
Mean	+0·199			
Greenwich.				
Apr. 27	+0·052	9,	14	1
28	+0·060	18,	17	2
May 1	+0·064	16,	12	2
2	+0·070	10,	14	1
3	+0·007	17,	17	2
Mean	+0·048			
Paris.	s			
Sept. 21	+0·204	15,	11	2
22	+0·120	16,	16	2
24	+0·121	17,	14	2
26	+0·118	16,	18	2
Mean	+0·141			
Greenwich.				
Sept. 29	+0·133	14,	14	2
Oct. 2	+0·032	16,	16	2
8	+0·079	20,	19	2
9	+0·077	10,	7	1
10	−0·019	19,	20	2
12	+0·057	12,	8	1
14	+0·095	19,	20	2
15	+0·087	14,	10	1
16	+0·081	20,	18	2
17	+0·033	16,	17	2
18	+0·138	17,	14	2
21	+0·041	20,	20	2
22	+0·199	15,	18	2
Mean	+0·072			
Paris.				
Oct. 25	−0·003	14,	13	2
27	+0·058	10,	8	1
28	+0·061	7,	13	1
29	+0·158	16,	17	2
31	+0·172	16,	17	2
Nov. 2	+0·157	17,	11	2
3	+0·187	20,	17	2
4	+0·234	20,	19	2
Mean	+0·138			

TABLE VIII. TABLE IX.

Transit C.—Observer, Mr. H. Christie.

Annular Illumination.

Date. 1906.		W—E. Means.	No. of Stars. W.	E.	Wt.
		s			
Nov.	5	−0·015	7,	7	1
	11	+0·652	2,	7	1
	19	−0·281	6,	4	1
	22	+0·118	14,	8	2
Dec.	9	+0·253	3,	3	1
	10	+0·316	4,	5	1
	13	+0·507	11,	10	2
	14	+0·410	3,	3	1
1907.					
Jan.	21	+0·386	7,	9	1
	26	+0·436	7,	7	2
	29	+0·321	5,	3	1
Feb.	1	+0·105	8,	6	1
	22	+0·323	17,	13	2
	28	+0·406	15,	17	2
Mar.	1	+0·146	9,	8	2
	10	+0·010	2,	2	1
	11	+0·435	4,	8	2
	22	+0·185	4,	6	2
	26	+0·198	3,	5	1
Mean		+0·277			

Central Illumination.

Date. 1907.		W—E. Means.	No. of Stars. W.	E.	Wt.
		s			
May	8	−0·029	16,	15	2
	10	+0·041	1,	6	1
	27	−0·015	7,	5	2
June	2	−0·023	12,	11	2
	10*	−0·001	11,	5	2
	17	−0·045	5,	6	2
	19	+0·046	15,	14	2
July	16	+0·047	7,	7	2
	17	+0·055	2,	2	1
Mean		+0·003			

* Observer, Mr. Hollis.

Note.—No correction for inequality of the pivots has been applied. The following determinations of the apparent inequality have been made with the striding level, showing that it is very small.

Date.		Apparent Inequality of Pivots.	Discordance W—E due to Pivot Error.
		″	s
1902	March–May	+0·05	+0·016
1902	Sept. –Nov.	−0·09	−0·029
1906	Nov. –Dec.	−0·09	−0·022
1907	Jan. –March	−0·12	−0·029
1907	April –June	−0·07	−0·017

The pivots have not been re-ground since 1901.

TABLE X.

Transit D.—Central Illumination.

Observer, Captain Monro, R.N.

Date. 1907.	W—E. Means.	No. of Stars. W. E.	Wt.
	s		
Sept. 18	−0·137	2, 3	1
19	+0·085	8, 10	2
23	+0·030	10, 8	2
24	+0·009	12, 10	2
30	+0·008	5, 8	2
Oct. 2	−0·014	8, 6	2
4	+0·150	9, 9	2
7	−0·052	8, 6	2
8	+0·021	8, 8	2
Mean	+0·020		

Observer, Lieut. Gibson, R.N.

Date. 1907.	W—E. Means.	No. of Stars. W. E.	Wt.
	s		
Sept. 27	−0·149	3, 3	1
Oct. 2	+0·019	7, 7	2
4	+0·096	8, 8	2
7	−0·089	6, 4	1
8	−0·020	5, 8	2
Mean	−0·006		

On the Orbit of the Binary Star β 80.
By T. J. J. See, A.M., Ph.D. (Berol.).

This interesting and rapidly revolving system was discovered by Burnham with his celebrated 6-inch telescope at Chicago in 1874. It was measured by Dembowski the following year, and has since been followed regularly by the most active observers of close pairs. At first the motion was very slight, because the companion was near apastron, with a long radius vector and revolving slowly. But in the last ten years the motion has become very rapid both in angle and distance. The apparent orbit quite well represents the observations, as shown by the accompanying diagram. The material used is the complete measures given by Burnham in his General Catalogue of Double Stars, just published by the Carnegie Institution. The place of β 80 for the epoch of 1880 is $\alpha = 23^h\ 12^m\ 45^s$; $\delta = +4^\circ\ 45'$; mags. 8·2, 9·1.

The elements are as follows:—

$P = 63{\cdot}5$ years	$\Omega = 107^\circ{\cdot}8$
$T = 1905{\cdot}30$	$i = 17^\circ{\cdot}6$
$e = 0{\cdot}726$	$\lambda = 10^\circ{\cdot}7$
$a = 0''{\cdot}626$	